Medical University of Graz

Investigation of the effects of Mg-based implants on cartilage tissue

Summary

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Supervisor:	Prof. Dr. Annelie-Martina Weinberg
Availability:	This position is available.
Offered by:	Medical University of Graz
Application deadline:	Applications are accepted between February 15, 2022 00:00 and March 28, 2022 23:59 (Europe/Zurich)

Description

Background:

Different studies presented the appearance of osteochondral injuries in association with knee or ankle trauma (1). Upon 993 knee arthroscopies, Arøen et al. calculated 11% with present cartilage pathologies (2). However, in 9% of paediatric cases of patellar dislocations, osteochondral injury occurs (3). Cartilage has only a low self-healing potential (4), therefore treatment becomes necessary otherwise resulting in considerable damage or discomfort. Generally, there are several therapy options including regenerative procedures (e.g. autologous matrix-induced chondrocytogenesis), autologous chondrocyte transplantation and transplant procedures. However, cartilage refixation with resorbable implants is a common surgical treatment in patients who suffer an injury with shearing of an osteochondral flake due to trauma of the knee or the upper ankle joint. Rüther et al. demonstrated good clinical and morphological results after refixation of osteochondral fragments with resorbable polylactide (PLLA) in a long-term study (5). Biodegradable materials such as Magnesium (Mg) and its alloys have become increasingly popular in recent years, as they offer many advantages over permanent implants, especially in the orthopedic field. Mg implants not only have a more suitable Young´s Modulus (6) when compared to permanent implants, they are also proven to possess osseointegrative (7), but also osteogenic properties (8). However, to date research in this field focusses mainly on the influence of named materials on bone tissue. In order to be able to guarantee suitability for osteochondral applications, more information on the influence of Mg-based implants on chondrocytes, as well as their degradation behaviour in articular areas is needed.

Hypothesis and Objectives:

Bioresorbable magnesium implants support osteochondral fracture healing with adequate gas formation. We expect clinically relevant parameters concerning fracture healing and implant safety for the use in osteochondral areas. Differences in implant degradation and gas evolution between bone and chondral tissue will be evaluated. Additionally, the aim is to differentiate in osteochondral diffraction patterns between different implant materials.

Methodology:

Preliminary *in vitro* experiments with juvenile human chondrocytes (JHC) and human mesenchymal stem cells (hMSCs) will be performed to evaluate the effect of magnesium ions on proliferation, differentiation and cartilage matrix synthesis. In order to investigate the suitability of Mg-based implants in comparison to different resorbable and non-resorbable implant materials for osteochondral applications, a long-term *in vivo* study using a sheep model will be performed. Clinical computed tomography (cCT) on certain time points and blood count analysis will be included to investigate implant behaviour locally and systemically. *Ex vivo* sheep samples should be used to perform high resolution micro computed tomography in order to investigate implant degradation over time. Histological analysis of the same samples should reveal information on the quality of different peri-implant tissue types. Additionally, the osteochondral diffraction pattern of different implant materials will be investigated by SAXS analysis.

References:

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